Art. XXIII.—*On the Past and Present of the Port of Melbourne, and Proposed Works for its Improvement.*

By T. E. Rawlinson, Esq.

[Read 13th December, 1875.]

In resuming the question of harbour accommodation for Victoria, after a lapse of twenty years, it is with advantages which did not exist then.

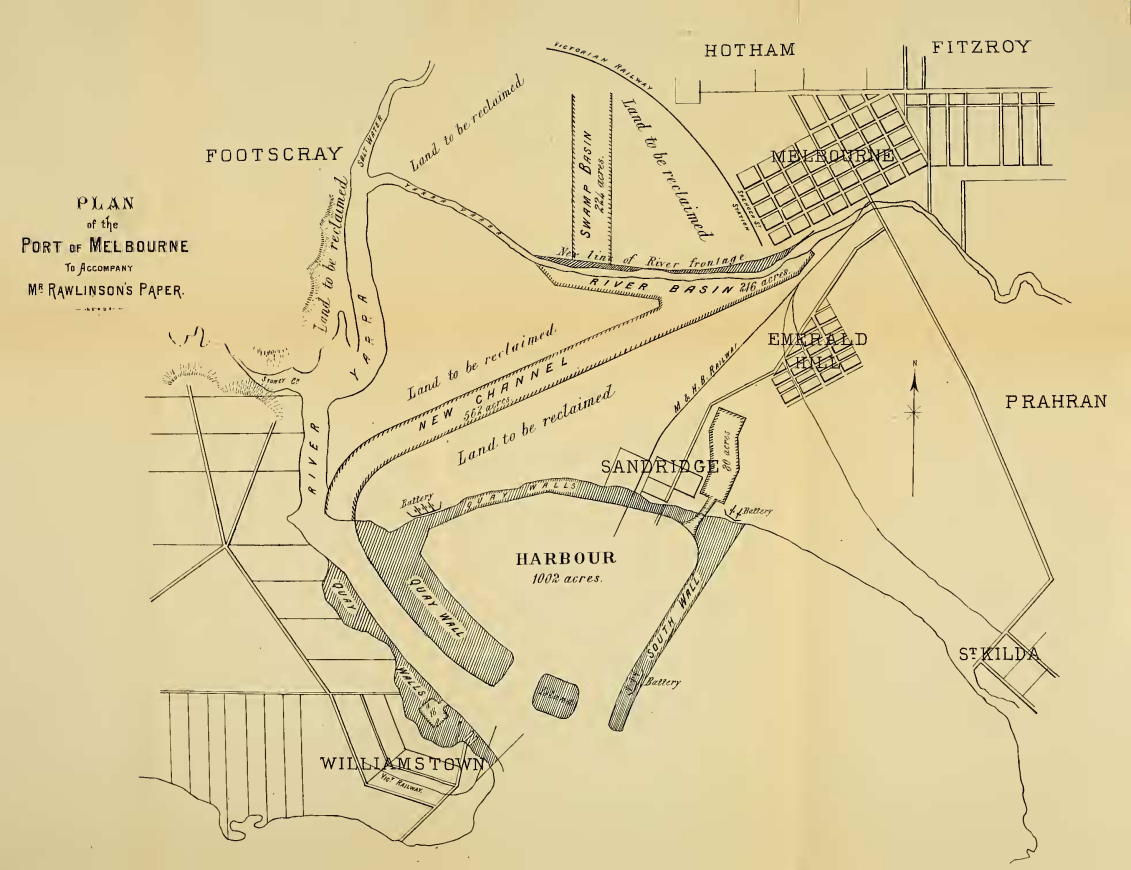
It was pointed out that Hobson's Bay and Port Phillip Gulf, if left to natural agencies, would in time become things of the past; but it was little anticipated that such would be so far facilitated by future harbour improvements.

Whilst left to itself Port Phillip Gulf was slowly but surely silting up, in accordance with natural laws, as other gulfs and inland seas have filled before; and evidence of this fact exists in the made lands now lying between Sandridge and Flemington, whilst the lines of soundings in the bay indicate the same continuous action of shoaling and filling, partly caused by the littoral drift created by prevailing winds from the south and south west, and partly by the deposit brought down by the rivers and creeks being precipitated in the bay.

The increase of land, owing to drift from the south east, is shown by the make of foreshore at Sandridge; but the shoaling from river silt was not so perceptible, owing to the river being permitted to sweep past the Williamstown shore and precipitate in the waste of waters southwards towards Point Cook, and possibly with certain winds towards Brighton; whereas now, the recently constructed stone dykes at the river mouth has diverted the Yarra waters direct into Hobson's Bay, where the current is rapidly lost, and precipitation takes place there.

To better understand the question, it will be well to take a retrospect of Hobson's Bay in 1853, and compare it with the bay as existent in 1875.

In 1853, with the exception of one or two small boat piers at Williamstown, which lay almost out of the stream, the waters of the River Yarra had a clean sweep along the land, with a sharp set of current around Point Gellibrand, leaving a comparatively clean foreshore; whilst on the Sandridge side there existed the Government and the Railway Piers, and a


PLAN
of the
PORT OF MELBOURNE
To Accompany
Mr RAWLINSON'S PAPER.
HOTHAM
FITZROY
MELBOURNE
FOOTSCRAY
Victorian Railway
Land to be reclaimed
Land to be reclaimed
SWAMP BASIN
22½ acres
Land to be reclaimed
New line of River frontage
RIVER BASIN 216 acres
Land to be reclaimed
NEW CHANNEL
562 acres
Land to be reclaimed
EMERALD HILL
PRAHRAN
SANDRIDGE
HARBOUR
1002 acres.
QUAY WALL
SOUTH WALL
Battery
ST KILDA
WILLIAMSTOWN
RIVER YARRA

narrow strip of beach opposite Liardet's hotel, while a line of sounding extended south-west and south into and down the bay, indicating the edge of the littoral drift from the east, south, and south-west.

In 1875 there is a serious change of all this; for at the river entrance we have a stone dyke, which, as constructed diverts the river waters direct into the centre of Hobson's Bay, and the foreshore of Williamstown literally bristles with piers, extending well into deep water, which effectually diverts any feeble remnant which may be left of the river current from its original course in 1853. On the Sandridge side the piers have been extended further into the bay, but this, as will be afterwards shown, is in such locality as great a benefit as on the Williamstown side similar structures have been and are mischievous. The increase of foreshore in front of Liardet's and the creep westwards of the line of shoal water, are the natural and unavoidable consequence of causes which are beyond man's control.

Such was the position of things as existent in 1853-4, and we have now this lamentable difference, that in 1875 there is several feet less of depth of water in Hobson's Bay, and the foreshore of Williamstown is silted up with mud.

Under the circumstances it should surprise no one that such injurious changes have taken place, because theory points out that we ought to realise them under the conditions given, namely, checking of the river current and its diversion into the still waters of the bay.

A consideration of the causes which have been, and are still in operation forming and moulding the shores of Hobson's Bay and of the River Yarra, and afterwards a brief allusion to the laws governing the precipitation of matters held in mechanical suspension in water, will aid in showing the origin of much of the mischief done within the past twenty years.

I premise that no geologist will question that the site now occupied by the low lands between Sandridge and Flemington, within a comparatively recent period, formed a portion of the Port Phillip Gulf, Emerald Hill existing as an island, the River Yarra entering the bay at where Prince's Bridge now stands, the Saltwater entering at the racecourse, and the Moonee Ponds at North Melbourne.

That in the course of time, owing partly to solid matter brought down these several streams, deposits formed at the

mouth of each as they lost their current in the still waters, whilst the prevailing winds from the south and south-west brought up the littoral drifts along the shore, continuously edging the waters of the River Yarra along the side of the rising land on the north, and forcing it to form the curved bend to the north, known as Humbug Reach, until joining with the Saltwater, they kept the edge of the high and rocky foreshores of Footscray and Williamstown; sweeping past Point Gellibrand, the current became dissipated in the still waters of the gulf southwards.

Such is a brief theoretic history of the formation of Hobson's Bay and the channel of the River Yarra, as inferred from the teachings of geology in the operations of nature elsewhere, to which causes may probably be added the slow upheaval of our coasts, as evidenced in the old raised estuary beds between Corio Bay and Bass's Straits.

Assuming the above theory to be granted as highly probable, if not absolutely true, it follows that if Port Phillip be left to itself, it can only be a question of time for the complete filling up, not only of Hobson's Bay, but the gulf itself (the same agencies remaining in operation), being a natural sequence of cause and effect.

It is a fact established beyond all doubt, that all land degrades, and all waters shoal, following the natural law of change; but that areas of water receiving running streams shoal more rapidly than waters remote from such action, because running streams carry more or less of solid matter in mechanical suspension of a fineness proportioned to the velocity of the current, which solid matter is precipitated on losing its velocity, and from fresh water more rapidly on entering brackish or saline waters.

Now in the case of the River Yarra prior to 1853, it debouched nominally at what is called the river entrance, but practically, from the pressure of littoral currents along the coast from the south and east past Sandridge, and along the north side of the bay, it was facilitated in its flow along the Williamstown shore, owing to all such littoral currents turning to flow with the river stream until past Point Gellibrand, from whence, having no controlling line, it enters into the broader waters and becomes lost; and this view of the case is justified, because when the river is most surcharged with mud, and discharging the heaviest freshets, the winds usually blowing are strong from the south and south-west against the Brighton and St. Kilda shores,

causing a littoral drift northerly and westerly past Sandridge towards the river's mouth.

Such being the state of things prior to 1853, I propose to examine what has been done since, and show the consequences which theory leads us to expect, and what practice has actually realised.

The construction of the stone pier and timber jetty at Point Gellibrand and other timber jetties for the railway in the vicinity, should, in accordance with theory, obstruct and divert the current previously existing along the shore at these points, and cause deposit, whilst the stone walls at the mouth of the river must absolutely turn the stream into the bay in the direction of Sandridge, and in doing so destroy its current, and cause precipitation of all solid matters held in suspension, and this precipitation will take place much more rapidly on entering saline than in fresh waters. Such are the teachings of theory, and they may be illustrated by examples from practice.

The rivers entering the sea on our south coast have all bars, and the rivers Latrobe and Mitchell are excellent examples of bars in slightly brackish water, formed under precisely similar conditions to those existent in Hobson's Bay, whether natural or artificial, but more especially the latter.

Of the influence of open timber piling in checking currents and causing deposit, I beg to instance two or three which have fallen more immediately within the range of my own experience and observation. At Caernarvon, in North Wales, the River Sieont enters the Menai Straits, and at its mouth a stone pier was built out to accommodate the shipping ; but this being at right angles to the tidal current, became silted up, and was extended further out with open timber piling ; but this also silted up, and about 1846 and '47, a further extension of timber pier was run out also at right angles to the stream, finishing with an L end parallel to the current, but before I left the district in 1850, the direct extension had silted up, whilst the L end being exposed to the direct scour remained clear, showing how very influential open timber work is in checking and diverting current, and causing deposit.

The next instance is an extension of the Beaumaris Pier, also in the Menai Straits, which being at right angles to the current, diverted it, and also caused deposit.

The next instance is the old pier at Leith, in the Firth of

Forth, which was of open timber work, and was sufficient obstruction to the passage of waves, that I have seen the outside surface a mass of white water, whilst inside it was comparatively smooth, and this at a time when, owing to the fury of the gale blowing, the spray was breaking nearly over the Bass Rock. This last case is an illustration of the influence of open piling in checking wave action, and if wave action, also currents.

The above are given only as examples of cases which exist in abundance, proving that currents are checked by open timber piers, as well as by stone walls, and that both theory and practice show that when such check takes place, matter held in mechanical suspension must precipitate.

Now if we examine what has taken place on the Williamstown shore and in Hobson's Bay since 1853, we find precisely the results which theory and practice point to as a probable consequence of what has been done there, namely, a rapid filling up in Hobson's Bay and heavy deposits of mud on the Williamstown shore, owing to the stone walls and timber piers having diverted the river currents, whereas the shore used to have a clean surface of rock and kelp before the construction of the works named.

It is no unusual thing now, for one of our Colonial steamers in passing Williamstown, to leave behind her a trail of putrid mud, and it is only a few days ago a paragraph appeared in the daily journals to the effect that mud had deposited so thick at the steamboat jetty as to render it inconvenient for use by the boats of light draft plying at the pier, which is a state of things I imagine few will regard as an improvement on the waters of 1853.

In time of freshets, the river bringing down waters heavily surcharged with mud, the brown water can be seen as diverted by the stone walls right across the bay to Sandridge, whilst the waters south of Point Gellibrand are comparatively translucent. After heavy westerly weather, when the waters of the bay rise above the stone dykes, the brown water may be seen driven over into the Williamstown recesses, but with little or no current, and it is indicative of the extensive character of the mischief being done. The actual extent of the evil is only realised by reference to the soundings by Captain Cox, and more recently by Commander Stanley.

It has been suggested to me that the shoaling of the bay waters may be accounted for by upheaval; but I do not

believe we have the slightest evidence of such within the period elapsed since the first settlement of Port Phillip, although there is evidence of it in times past, such as the raised estuary bed of Connewarre and Point Henry; but this evidence, although geologically recent, is historically remote, and has no bearing on the facts now discussed. Whereas we have direct evidence of deposits taking place where none existed before, and we can trace cause and effect in the construction of the works enumerated, and the consequent silting up on the foreshore and in the bay.

A quotation given by Commander Stanley, from one of the late Chief Harbour Master's (Captain Ferguson's) reports in 1866, alludes to the silting up of the bay as an established fact, and traces much of the mischief to the construction of piers in the bay, although he erroneously attributes the injury to their shutting out the tidal waters, instead of their direct effect in diverting the current of the river; being right in fact, but wrong in theory.

Captain Cox notes on his chart that from 1864 to 1866 two feet of deposit was made in Hobson's Bay, whilst Commander Stanley is most absolute and positive in his evidence as to the rapid filling in of the bay between the period of Captain Cox's survey and the date of his own, and in attributing very much of the mischief to the form and position of the stone walls at the river mouth having diverted the muddy waters into the bay; and in recommending the early removal of the cause of such a large amount of injury.

One valuable result of the late surveys is, the absolute proof given of the rapid silting up and its general direction. Commander Stanley informs us that the six feet water line has advanced towards St. Kilda at the rate of 1,100 ft. in eleven years, and at a similar rate of progression, it will take only eighty years to reach St. Kilda; but, as a matter of course, long before that period, Hobson's Bay will have ceased to have an existence. Such a statement from so competent an authority is a very serious one indeed, and gives point to warnings written twenty years ago, when treating on the question of a harbour for Melbourne, the following expressions were used: "Having satisfied ourselves that the process of silting up is going on slowly although surely in the bay, we are prepared to meet this difficulty in the usual way when necessary to do so by dredging, but in this we apprehend none; and as to the expense, it is

only a question that must arise sooner or later to any dock pier or harbour constructed in Hobson's Bay, it being only a question of time when Hobson's Bay and Port Phillip Gulf itself will no longer exist, so surely is the process going on by which this inland sea will be converted into dry land, as former seas and lakes have been before, from the date of creation up to the present day." Such was the language of myself and the gentleman acting with me in these matters at that time, but we never for a moment supposed that natural agencies would receive such an impetus by the construction of the stone walls at the river mouth, and timber piers in front of Williamstown.

Whilst availing myself of the very valuable series of results of the recent survey of the bay, as given by Commander Stanley, I must demur entirely to the prudence of the remedial measures as set forth in his direct canal scheme, and in a more modified form to his proposed extension of the Sandridge Lagoon into a blind canal or long dock. To cut a direct canal from the Queen's basin to the bay, anywhere near to the Railway Pier or Baths, would be most disastrous in its results in every way, whilst its alleged advantages are wholly mythical. A diversion of the river through the short canal would of necessity weaken the scouring power, as it exists at the present entrance, where the waters of the Moonee Ponds and Saltwater Rivers, with those of Stony Creek, are all concentrated with those of the River Yarra, and are available, in so far as such a power under the especial circumstances of a low rise and fall of tide are useful; and in the next place an entrance at such point would ensure the very worst results of precipitation in forming a bar, and hastening the silting up of the bay. There is no scheme which could be more disastrous, and I am happy to find that Mr. Gordon has arrived independently at the same opinion on this point

The difference in length between the direct canal and the longer one by way of the present embouchure is an advantage in favour of the longer line, because every yard of quay room on the longer line is valuable for trade purposes, and every cubic yard of material excavated is valuable for raising and reclaiming land which is now liable to flood, whilst the trifling difference in time of transit is an unimportant item to shipping. The blind canal or long dock would, in my opinion, be found seriously to inconvenience trade in another way, and be excessive in providing for the require-

ments of the locality, whilst the material available for embanking being so far from the place required, would be costly in removal. I do not concur in Commander Stanley's opinion as to the alleged evil result of ships lying alongside the piers, for supposing any current to exist transverse to the line of pier, the tendency would be to create an under draught below the ship, and whilst such existed it would be beneficial rather than otherwise.

The evidence afforded by Commander Stanley of the make of foreshore at Sandridge, and the shoaling of water between that place and St. Kilda, is valuable in pointing out the existence of another source of danger to the bay, in the alleged existence of a littoral drift past Sandridge in the direction of the Yarra mouth, as before alluded to in this paper. The make of the foreshore in front of Liardet's, from a few feet to several chains between the house and high water mark, and the contour of the soundings between Sandridge, St. Kilda, and Brighton, have all told the same story of increase, and from the quarter which Commander Stanley's recent report and survey confirms; but I shall have occasion to speak of this drift when submitting my suggestions for improvements in the harbour.

Mr. Gordon's report on the navigation of the Yarra evinces his usual careful summary of facts bearing on the case, and as before remarked, it is most important to have the benefit of his opinion so decidedly expressed in favour of the retention of the embouchure of the river in its present position near Williamstown; and I attach greater importance to his opinion in this matter because of the persistent advocacy by many of the "direct canal," in the face of a series of adverse facts, and in direct opposition to the teachings of theory and of practice, but more especially the lessons taught by results in Hobson's Bay.

The principal objection I have to Mr. Gordon's proposals is that they do not go far enough, and are only adapted to meet a part of the difficulties which exist; and being in the nature of expedients are more likely to embarrass future operations. Under the circumstances I beg to enter a protest against any works being undertaken which are not part of a comprehensive general scheme adapted to the difficulties of our position and suited to the several requirements of the case, and from this stand-point protest against all expenditure in the river whilst the question is left untouched as to the silting up of the bay, because if we cease to have a harbour,

a large expenditure in the Yarra will be money thrown away. The Queen's Wharf basin is far from being a credit to us, and it is impossible that merely shortening the river bends can be of much avail whilst we retain the narrow channel of the river, bound in as it is with buildings and wharves, to the obstruction of trade and shipping; and I submit that it is useless to incur the expense of further deepening the river, unless we are prepared to widen it to allow room for working the vessels in the river basin.

The great evil of the past has been that marine works in and about the river have been carried on apparently as matters of temporary expediency, and on no definite or comprehensive plan, by which each portion however small should be part of a complete whole; and it is with a hope of showing the necessity for the adoption of some systematic plan of works which shall be capable of affording immediate relief for the present, and yet be part of a general system capable of future extension and completion, that I have undertaken this paper. As a physician first makes a diagnosis of his patient's ailment before attempting to cure, so I now endeavour to point out the physical defects under which we have been and are suffering, before suggesting remedial measures; and it is for this reason I have given an epitome of what our river and harbour was twenty years ago, and what it is, pointing out the consequences of what has been accomplished, and by inference showing what ought to be done now.

The ports on the western coasts of England are notable examples of the evils experienced by silting up, and perhaps the most remarkable of them is the old Port of Chester, which, owing to the silting up of the estuary of the River Dee, is now but an inland city, its whole sea trade being such as can be carried along an artificial canal.

Liverpool, with its magnificent estuary of the River Mersey and its noble line of docks, would in a few years become impracticable for large vessels, and be silted up with mud, if it were not for the systematic skill of the engineers in charge in dredging, sluicing, and other means for keeping the port clear of accumulation.

Under present conditions, Hobson's Bay is rapidly filling up, and of late years the so-called improvements have rapidly accelerated the process, so that if allowed to go on without interruption it cannot be a very remote period before the River Yarra will have to wind a sluggish course through marsh lands to the Heads, as the River Thames

passes from London in its course to the German Ocean; with this disadvantage, we have here no corresponding lift of tide to give us the scouring power which exists in the River Thames.

In reference to the condition of the river and the low lying lands between Emerald Hill and Melbourne, Mr. Gordon has very justly remarked, that in the case of heavy floods we are in a worse position now than on the occasion of the disastrous 14th December, 1863.

The remedy I propose for the above evils is, the removal of Raleigh and Cole's, and the Australian wharves, and widening the river basin to 1000 feet to below the Gasworks, and cutting an entirely new channel 1000 feet wide from the Queen's Wharf basin in the direction of Stoney Creek, entering the bay at the old embouchure at Williamstown, and removing the whole of the stone dykes constructed at the lower end of the Yarra, and deepening the river, to give not less than 20 feet at lowest tide. Such a width of channel would give ample space for the outflow of flood waters, and the drawback of deposit must be met by dredging. Many have objected to the length of the new channel, and no doubt such objections will be strengthened by the extreme width and depth proposed; but when it is borne in mind that every yard of material excavated is highly valuable as a means of reclaiming land, which at present is worse than useless, such objections ought to be allowed to fall to the ground.

On the western side of the Gasworks, a water float excavated as shown would not only accommodate a large trade, but afford materials for reclamation of land which at present is but a noxious swamp; and in lieu of a pestilential marsh, give us land worth from five to six thousand pounds per acre.

By extending the eastern wall of the river at the entrance as shown, the current would be confined to its proper channel, and check deposit in the bay from that source; whilst on the east, from a point a little below the present lagoon at Sandridge, a wall carried out over the rocky shoal into five-fathom water would check the littoral drift from the south and east. The lagoon at Sandridge should be converted into a dock, as shown, with an entrance from the harbour, the materials from which dock would reclaim land equal in value to the cost of construction.

On the Williamstown shore the river current should be

regulated by a sea wall having a dock formed in the deep bend as shown, and indented with basins for the patent slip, graving dock, and timber piers where required, by which means the current of water both entering and flowing out of the river would be restrained to certain limits, within which no obstruction would exist to divert it from its proper course.

With such a system of retaining walls and channels, Hobson's Bay when once dredged out to the proposed depth of 30 feet, would have little or no deposit, for the sources from whence it is now derived would be cut off, owing to the river waters being kept out and the littoral drift from the south stopped.

In the Queen's basin the river and new channel, the deposit would after freshets be continuous, but it would be under conditions easily dealt with by the dredge, and being thus dealt with at the upper part of the river, the great evil of deposit in the bay would be materially lessened.

One of the results to be anticipated in the bay outside of the harbour would be the rapid make of foreshore south eastward of the east wall, but I should not deem this an evil, owing to the fact that as we must have shoaling and making of foreshore somewhere in the gulf, it is just as well to let it occur where in place of doing harm it will do good, by reclaiming land which at some future day will be valuable.

It may be urged that such a scheme of works as above suggested is much beyond our present requirements, but to this I say most decidedly no, because in executing them it is not sinking capital, but creating it by giving value to lands that are now worthless, and which are even now wanted for the extension of business, and this creation of capital will be a certain result if the work is carried out with economy and prudence.

In the general estimate of cost which I annex, provision has been made for facing the walls with concrete, coped with wrought bluestone, and faced with the usual fender piling.

The estimated cost for a completed scheme of works as above suggested, and shown on plan, would be wholly recuperated by the value of the reclaimed lands, and the whole cost of after working and superintendence, defrayed from the leasing of wharf sites and frontages, so as to give a free port and harbour, save and except light and pilot dues.